

Hurricane Sandy Mitigation/Resilience Projects Overview and Specific Project Examples

The Hurricane Sandy Disaster Relief Supplemental Appropriations Act of 2013, Public Law 113-2, appropriated \$360 million to the Office of the Secretary of the Interior with authority to transfer funds to bureaus and offices and to enter into financial assistance agreements for mitigation. The Act provides explicit direction to use mitigation funds to restore and rebuild national parks, national wildlife refuges and other federal public assets; and to increase the resilience and capacity of coastal habitat and infrastructure to withstand storms and reduce the amount of damage caused by such storms.

The U.S. Fish & Wildlife Service (FWS) submitted 46 proposals in response to the Hurricane Sandy Mitigation Department of the Interior (DOI) request for proposals, dated June 2, 2013, totaling \$129,701,683. FWS successfully competed for 31 projects for **\$102,065,525** of the \$161,958,125 awarded by DOI.

FWS projects are designed to increase resilience by restoring coastal marshes, conducting beach and dune restoration, improving aquatic connectivity in streams and rivers, and by providing integrated science decisions through LCCs that bring partners and science together to reduce redundancy and increase the effectiveness of conservation actions.

Projects were developed in collaboration with many partners and have the support of other federal agencies to support recovery efforts and demonstrate improved sustainability to meet long-term management needs. Projects address vulnerability to climate change impacts based on key climate information and future projections to create greater resilience to future extreme weather events and changes in natural processes, and they support improved and climate-resilient wildlife habitat and ecosystem functions. Emphasis was placed on projects in areas that were most severely affected by Hurricane Sandy, including the states of New York, New Jersey and Delaware, as well as other states affected by this storm. Projects were submitted based on feasibility of completion within three years with the necessary design, engineering and permits.

Devastating weather events are predicted to increase and sea levels will continue to rise. Restoring aquatic connectivity and preserving and rebuilding natural ecosystems such as coastal marshes and beach and dune habitats will benefit and better protect wildlife, communities, and the economy.

Summary of Funded Project Proposals

Summaries of approved resilience projects that are moving forward and specify precisely allocated funding have been prepared for public dissemination. At this time, FWS can provide these summaries of projects as they were proposed to the Department of the Interior, and which are here identified by those proposal numbers.

Funding amounts represent the total amount of money funded for each project. Specified funding includes costs such as: project design fees, project management fees, administrative oversight fees, construction costs, and any other contingencies.

The range of funded project proposals includes:

- **Fourteen (14) coastal marsh restoration** proposals that will restore significant acreage to wetland habitats across the eight impacted states in the Northeast. The total funds requested for these projects are \$75,896,425. They are expected to deliver over \$130 million of socioeconomic benefit to local economies. Marsh restoration efforts not only provide habitat to fish and wildlife resources, but also give protection to shorelines, infrastructure and coastal communities from storm surge and flooding. Projects will also provide transition time to allow for upslope migration of marshes in response to sea level rise. The rate of sea level rise may preclude the migration of marshes unless active management of marsh complexes is coordinated among state, federal and local communities.
- **One (1) beach restoration** proposal in NJ, totaling \$1,650,000, will protect important coastal areas, associated marshes, provide valuable habitat for natural resources and provide significant economic benefits to state and local communities. Projects will protect coastlines through wave attenuation, improving ecosystem connectivity, improving habitat for migrating and nesting birds, and by their ability to protect wildlife habitat and adjacent lands.
- **Nine (9) aquatic connectivity/resilience** proposals focused on dam removals and culvert replacements, totaling \$10,448,150, will restore fish access to 138 miles of stream and 526 acres of pond habitat in seven impacted states throughout the Northeast. They are expected to deliver approximately \$50 million in socioeconomic benefit to local economies. These projects will build resilience into the future by helping to prevent future flooding, restore and recover aquatic species and their habitat, decrease coastal beach and marsh erosion that occurs when natural river sediment transport is disrupted at dams, and provide for the protection of roads and other infrastructure that is otherwise threatened in major storm events. For example, bridges and open-arch or bottomless culverts have the advantage of allowing for passage of riverbank-full flood flows, storm debris and sediment load, which contributes to fish population resilience, infrastructure stability, and protection of human health and safety.
- Additionally, **seven (7) science/decision support** proposals, totaling \$20,279,733, will guide decisions on allocation of resources for restoration efforts in response to Hurricane Sandy impacts and future allocation of resources for conservation efforts. This effort will assist the FWS and partners in determining where actions will increase the persistence of marsh, beach, and aquatic habitats and species as well as improving recreational opportunities and ecosystem services such as flood abatement.

Project Summaries by State

Connecticut

DOI # 51

Project Title and Amount:

Pond Lily Dam Removal, West River, New Haven, CT - \$661,500

Conservation/Resilience Goal:

- Increase capacity for resilience and eliminate liability
- Facilitate migratory fish passage and habitat

Brief Project Summary:

The Pond Lily Dam Removal project will increase capacity of the local coastal riverine habitat to withstand storms by eliminating the hazard of Pond Lily Dam's likely failure and restore a federal public asset by promoting migratory fish passage of federally protected species. The project eliminates threat of a catastrophic dam breach during future flooding. In total, approximately 2.6 miles of the West River and 76 acres of Konold's Pond habitat will be re-opened to migratory fish, including herring, eel and shad. The project has a socioeconomic benefit estimated at \$1.3M.

DOI # 53

Project Title and Amount:

Hyde Pond Dam Removal, Whitford Brook, Groton, CT - \$551,250

Conservation/Resilience Goal:

- Restore fish passage to 4.1 stream miles providing alewife, blueback herring and American eel with access to historic habitat
- Mitigate flooding risk downstream of the dam

Brief Project Summary:

The Hyde Pond Dam Removal project will remove the dam on Whitford Brook, a tributary of the Mystic River. It will restore fish passage to 4.1 stream miles and habitat for alewife, blueback herring and American eel, candidate species under the Endangered Species Act, and mitigate flooding risk downstream of the dam. The socioeconomic benefit is estimated at \$2M.

DOI # 68

Project Title and Amount:

Flock Process Dam Removal, Norwalk River, Norwalk, CT - \$970,000

Conservation/Resilience Goal:

- 3.5 miles of stream access will be restored benefiting migratory fish including alewife, American eel and blueback herring
- Dam failure risk will be eliminated protecting up and downstream infrastructure
- Natural sediment transport will be restored

Brief Project Summary:

The Flock Process Dam Removal project will remove the first dam on the Norwalk River, eliminating dam failure risk, allowing diadromous fish restoration, facilitating natural sediment transport and building resilience

in both upstream and downstream areas of the river to future flooding. Approximately 3.5 miles of stream access will be restored with an estimated socioeconomic benefit of \$1.75M.

DOI # 79

Project Title and Amount:

Norton Mill Dam Removal, Colchester, CT - \$727,650

Conservation/Resilience Goal:

- Restore access to habitat for migratory fish species
- Eliminate dam safety liability and protect downstream property

Brief Project Summary:

The Norton project will restore access to 17 miles of habitat and provide an estimated \$8.5M in socioeconomic benefit to its locality. Aging infrastructure damaged repeatedly by flooding and dam safety liability will be eliminated, protecting downstream property. Eastern Brook trout, Atlantic salmon, American eel and river herring will benefit.

Delaware

DOI # 15

Project Title and Amount:

Prime Hook National Wildlife Refuge Coastal Tidal Marsh/Barrier Beach Restoration – \$19,805,000

Conservation/Resilience Goals:

- Restore a resilient tidal marsh/barrier beach complex
- Provide habitats for migratory birds and fish for future generations
- Stabilize this habitat complex, providing storm surge protection and other ecosystem services for coastal communities directly connected to Prime Hook NWR

Brief Project Summary: The purpose of this project is to restore a highly damaged tidal salt marsh/barrier beach ecosystem within the former impounded wetland system on Prime Hook National Wildlife Refuge. This coastal wetland restoration will be guided by the results of an ongoing hydrodynamic modeling and alternatives analysis, and will provide ecosystem services and economic benefits to several adjacent and nearby communities in Delaware.

Maryland

DOI # 31

Project Title and Amount:

Fog Point Living Shoreline Restoration, Martin National Wildlife Refuge – \$9,000,000

Conservation/Resilience Goals:

- Reduce erosion along a coastal section of Martin National Wildlife Refuge. This project will dissipate wave energy and slow erosion, increasing the resilience of refuge estuarine habitats and the local economy to storm events.

Brief Project Summary: The FWS will construct 20,950 feet of “living shoreline” that will stabilize a highly vulnerable shoreline at Martin National Wildlife Refuge and directly protect over 1,200 acres of high quality tidal high marsh, submerged aquatic vegetation, and clam beds. This green infrastructure project will ensure that these fisheries resources will continue to provide economic benefits to the fishing communities directly connected to MNWR: Ewell, Tylerton, and Rhodes Point, on Smith Island. This project directly contributes to the *Protecting and Restoring the Chesapeake Bay Watershed Initiative* with federal accountability enacted by Executive Order 13508.

DOI # 57

Project Title and Amount:

Hail Cove Living Shoreline Restoration, Eastern Neck National Wildlife Refuge – \$1,550,000

Conservation/Resilience Goals:

- Reduce erosion along a section of Eastern Neck National Wildlife Refuge from the Chester River.

Brief Project Summary: The FWS will construct 4,000 feet of “living shoreline” that will stabilize a highly vulnerable shoreline at Eastern Neck National Wildlife Refuge and directly protect over 400 acres of high quality tidal marsh and submerged aquatic vegetation in the Chester River. This green infrastructure project will ensure that these habitats continue to provide ecosystem services to the human communities of the Chesapeake Bay.

DOI # 85

Project Title and Amount:

Ferry Point, Nanticoke River, Pocomoke Sound Marsh Enhancement - \$638,000.

Conservation/Resilience Goals:

- Enhance and restore wetlands in the Chesapeake Bay Watershed
- Improve habitat conditions and increase resilience to the effects of sea level rise
- Protect infrastructure

Brief Project Summary: This project will enhance and restore 2,600 acres of wetlands in the Chesapeake Bay Watershed by treating invasive species and restoring the natural hydrology of impacted wetlands.

DOI # 89

Project Title and Amount:

Aquatic Connectivity and Flood Resilience in Maryland: Removing the Centreville Dam in Centreville and the Bloede Dam in Catonsville, MD - \$1,212,750

Conservation/Resilience Goals:

- Restore fish access to habitat
- Protect local infrastructure from the risk of catastrophic dam failure and flooding
- Restore natural sediment transport and river function

Brief Project Summary:

Flood resilience in Maryland will be restored at two locations. Removal of the Centreville Dam provides unimpeded passage for river herring and American eel to two miles of spawning habitat in Gravel Run. Natural river function will be restored when impounded sediment is removed and riparian vegetation is restored. A local municipal building, evacuated several times in floods, will be protected from future flooding. Removal of the Bloede Dam restores herring, eel and American shad access to 9 miles of upstream, historic spawning habitat. Two of four dams on this river have already been removed. Removal restores river function, reduces threat of flood, and protects sewage infrastructure. The two projects combined provide an estimated socioeconomic benefit of \$5.5M.

Massachusetts

DOI # 9

Project Title and Amount:

Whittenton and West Britannia Dam Removals, Mill River, Taunton, MA - \$650,000

Conservation/Resilience Goal:

- Restore fish river access and pond habitat
- Eliminate the threat of catastrophic dam failure in future flooding

Brief Project Summary:

The purpose of this project is to remove two aging mill dams from the Mill River in Taunton, Mass. and increase the resilience of natural and human infrastructure. The project will open up 30 miles of high quality habitat for American eel and river herring, which are under consideration for federal listing. It will also reduce the probability of flooding and eliminate the potential for catastrophic dam breaches posed by these obsolete dams. The socioeconomic benefit to the locality is estimated at \$15M.

DOI # 10

Project Title and Amount:

Round Hill Salt Marsh Restoration Project, \$2,277,000

Conservation/Resilience Goal:

- Mitigate coastal flooding through enhanced drainage and improved tidal dynamics of the larger Meadow Shores marsh complex during coastal storm events.

Brief Project Summary: This project will directly restore 11.6 acres of salt marsh functions and values lost for nearly 100 years due to historic filling. It will also protect and enhance the ecological integrity of the connected 70-acre Meadow Shores Marsh by enhancing the inlet through which the tidal waters that sustain these marshes flow, and increase tidal flushing to the existing marsh. This will be accomplished by directly removing up to 75,000 cubic yards of fill material from the marsh, re-vegetating, and replacing the defunct wooden culvert beneath Ray Peck Drive with a larger, properly-sized culvert for unimpeded tidal exchange within the restored marsh.

DOI # 11

Project Title and Amount:

Muddy Creek Wetland Restoration Project - \$3,762,000

Conservation/Resilience Goal: The goal of this project is to restore natural tidal flow to the Muddy Creek system by replacing outdated culverts that restricts flow. Project objectives include enhancing coastal system resilience through the restoration of a mix of approximately 55 acres of estuarine and subtidal wetlands, improvement of water quality, and restoration of passage for diadromous fish.

Brief Project Summary: The Muddy Creek project site is a tidally-restricted estuary with fringing degraded tidal marshes. Objectives include enhancing coastal system resilience through the restoration of a mix of

estuarine and subtidal wetlands, improving water quality, and restoring passage for diadromous fish. Restoration actions included the removal of twin undersized 3 ft. x 3 ft. stone culverts and replacement with a 94-ft. span bridge and open channel.

DOI # 33

Project Title and Amount:

Parkers River Restoration Project, \$3,718,000

Conservation/Resilience Goal:

- Restore 60 acres of salt marsh
- Improve 93 acres of fish and shellfish habitat in tidally-influenced Seine Pond
- Improve diadromous fish passage to the 63 acres of spawning habitat and approximately 5,500 linear feet of stream habitat.
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Brief Project Summary: The Parker's River Restoration Project will restore natural tidal hydrology to a 219-acre estuarine system (tidal river and coastal salt pond) through replacement of a tidally-restrictive bridge with a larger span structure, and enhance diadromous fish passage through replacement of two underperforming fish passage structures. The project will improve coastal system function and resilience, and improve diadromous fish passage. Two fish passage structures with inefficient passage will also be replaced as part of the project.

DOI # 43

Project Title and Amount:

Restoring Resilience to the Great Marsh, Parker River NWR, MA – \$340,000

Conservation/Resilience Goals:

- Build the resilience of the upper Great Marsh (27,000 acres)
- Determine tidal alteration impacts of the Plum Island Turnpike, remove tidal flow restrictions, and reduce the extent and threat of spread of harmful invasive plants

Brief Project Summary: We will increase the resilience of a 27,000 acre tidal marsh system by improving tidal channel hydrology, reducing marsh subsidence and retention of freshwater and controlling large outbreaks of invasive species through traditional and innovative measures. We will address issues of coupled natural-human environment by modeling impairment of tidal circulation posed by Plum Island Turnpike and take appropriate actions to improve tidal function.

New Jersey

DOI # 6

Project Title and Amount:

Increase Resilience of Beach Habitat at Pierce's Point, Reed's Beach, and Moore's Beach, New Jersey - \$1,650,000

Conservation/Resilience Goal: The loss of important beach habitat along Delaware Bay has immense ramifications for high priority shorebird species such as the red knot, a species considered for listing under the Endangered Species Act. Numerous other shorebird species rely on the eggs of spawning horseshoe crabs to fuel their spring migration to the Arctic to breed. Restoration of beach habitat in these areas is critical to maintain the beaches for spawning. Specific project goals are to remove rubble and other debris from the beaches prior to re-nourishment to ensure access for crab spawning, create an 80-foot wide berm at an elevation of +5.5 NAVD and replenish sand over a project length of 6,800 feet to create optimal spawning area for horseshoe crabs.

Brief Project Summary:

Several beaches along the Delaware Bay in New Jersey extending from Reed's Beach to Pierce's Point in Cape May County, and Moore's Beach in Cumberland County, were severely damaged by the storm. These areas serve as critical spawning habitat for horseshoe crabs which, in turn, serve as a food source for the red knot, an important shorebird being considered for inclusion on the Federal Endangered Species List. There was a loss of 2 to 3 feet of sand on all of these beaches and the force of the storm placed most of this sand well above the normal high tide line and out of reach of spawning crabs. The portions of beaches that did remain are covered with debris, including chunks of asphalt and bricks strewn throughout the substrate, which will have a significant impact upon crab spawning by negating their ability to dig in to lay eggs. In addition, larger debris such as concrete pipes, slabs, and pilings have created impingement hazards and will further hamper or prevent spawning. These beaches also serve as habitat for a number of other shorebirds, including ruddy turnstone, sanderling, dunlin, and shortbilled dowitcher.

This project will restore some of the most critically important stopover habitat for migrating shorebirds in Delaware Bay. The berm that will be constructed will ensure resilience of the habitat to future storms and the long term support of horseshoe crab spawning. Based on a partner project being developed with the ACOE to develop best management practices, the most environmentally appropriate methods will be used to mine sand, transport, and re-nourish these habitats.

DOI # 37

Project Title and Amount:

Restoring Coastal Marshes in NJ National Wildlife Refuges – \$15,000,000

Conservation/Resilience Goals: Mitigate the impacts of Hurricane Sandy addressing threats to the integrity and persistence of 36,000+ acres of impacted salt marshes and other coastal habitats at the Edwin B. Forsythe and the Cape May National Wildlife Refuges. Maintain and improve green infrastructure in coastal New Jersey by enhancing or restoring marshes that are deficient in sediment deposition or tidal flow, or altered by anthropogenic structures or actions, and implement living shoreline engineering techniques.

Brief Project Summary: Increase protection of communities along 60 miles of coastal New Jersey. Restore and enhance salt marshes as critical components of the green infrastructure supporting the communities, and protect the associated social, economic and recreational values of the New Jersey shore.

DOI # 77**Project Title and Amount:**

Gandy's Beach Shoreline Protection - \$880,000

Conservation/Resilience Goal:

- Restore saltmarsh and adjacent uplands
- Improve coastal resilience

Brief Project Summary: The FWS will construct 4,000 feet of living shoreline and breakwater to restore 337 acres of saltmarsh and adjacent uplands. This project will substantially improve the ability of the site to withstand storm surges and coastal erosion.

DOI # 94**Project Title and Amount:**

Aquatic Connectivity & Flood Resilience in NJ: Removing the Hughsville Dam in Pohatcong & Restoring the Wreck Pond Inlet and Dune in Sea Girt and Spring Lake, NJ - \$3,050,000

Conservation/Resilience Goal:

- Restore fish access/passage to a total of 7 miles of stream habitat
- Eliminate risk of dam failure at the dam removal site
- Provide storm surge protection for Sea Girt and Spring Lake

Brief Project Summary:

Flood resilience in New Jersey will be improved at two locations. Removal of the Hughsville Dam will reduce the risk of dam failure and upstream flooding while protecting human safety and restoring Trust fish species access to 5 miles of habitat. A box culvert replacement will provide for seasonal passage of fish in two miles of habitat, adds nesting habitat for piping plovers, and provides storm surge-dune protection for Sea Girt and Spring Lake. The project's total socioeconomic value estimated at \$3.5M.

New York

DOI # 1

Project Title and Amount:

Salt Marsh Restoration and Enhancement at Seatuck, Wertheim and Lido Beach National Wildlife Refuges, Long Island, New York – \$11,093,000

Conservation/Resilience Goals:

- Restore and enhance 432 acres of estuarine-salt marsh habitat in currently degraded salt marsh
- Ameliorate invasive species, waterlogging, extensive mudflat formation, shoreline erosion and high mosquito production
- Increasing salt marsh resilience to large storm events and reducing long-term vulnerability to sea level rise
- Repair and enhance an interpretative boardwalk trail system over the marsh to allow students of the Long Beach school district and neighboring school districts to experience the salt marsh ecology that Long Island depends upon

Brief Project Summary: Restore natural functions in damaged and degraded coastal salt marshes on Long Island through an integrated approach that addresses tidal hydrology, surface water habitat, invasive species, living shoreline stabilization and sea level rise. Restoration of natural hydrology will increase resilience and decrease long-term vulnerability and risk from storm events.

Rhode Island

DOI # 65

Project Title and Amount:

Protecting Property and Helping Coastal Wildlife: Enhancing Salt Marsh and Estuarine Function and Resilience for Key Habitats on Impacted Wildlife Refuges from Rhode Island to Southern Maine – \$4,150,000

Conservation/Resilience Goals: Mitigate the impacts of Hurricane Sandy on the salt marshes of John H. Chafee and Sachuest Point NWR, including significant storm surge impacts (e.g. flooding, vegetation death, marsh break up).

- Restore natural hydrologic flow and functioning to 300 acres of key salt marsh habitat
- Enhance and sustain marsh habitat and nesting productivity for federal trust species
- Enhance marsh resilience to sea level rise by improving drainage and increasing marsh elevations
- Reduce the frequency of flooding onto local roads, which prevents access to the refuge visitor center and town beaches
- Reduce the distribution of non-native species and prevent or limit infestations in the future
- Prevent coastal erosion while mitigating nutrient content, pollution and volume of storm water runoff

Brief Project Summary: We will increase coastal resilience to a changing climate for eight local communities, economies and wildlife that depend on healthy salt marsh ecosystems on over 400 acres in key coastal areas of Rhode Island, 50 acres in coastal Massachusetts and 50 acres in coastal Maine. We propose a variety of actions, including providing salt marsh shoreline protection, restoring hydrology, restoring maritime shrub lands adjacent to salt marshes, and instituting a monitoring/adaptive management program to protect salt marsh habitat for declining migratory birds and habitats at risk.

DOI # 21

Project Title and Amount:

Aquatic Connectivity and Flood Resilience in Connecticut and Rhode Island: Removing the White Rock and Bradford Dams and Assessing the Potter Hill Dam Fishway on the Pawcatuck River and removing the Shady Lea Mill Dam in North Kingston, RI - \$2,294,250

Conservation/Resilience Goal:

- Restore river connectivity and enhance fish passage at all four sites benefiting river herring, American shad and American eel
- Reduce the risk of dam failure and flooding during future storm events
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Brief Project Summary:

These projects will restore connectivity, enhance fish passage and reduce the risk of flooding during future storm events. The expectation is that 2 dams will be removed (and one fishway will be installed or repaired) on the Pawcatuck River in Rhode Island and Connecticut, and one dam will be removed from the Mattatux River in south-central Rhode Island, where a new natural riparian area will be created in the former impoundment. The total socioeconomic benefit of the projects is estimated at over \$11M.

Virginia

DOI # 34

Project Title and Amount:

Aquatic Connectivity and Flood resilience in VA: Replacing the Quantico Creek Culvert in Dumfries, VA - \$330,750

Conservation/Resilience Goal:

- Reduce potential for structural failure of the Quantico Creek box culvert
- Improve access to 6.25 miles of aquatic habitat for Service trust species

Brief Project Summary:

The project will replace an undersized/misaligned box culvert with an adequately sized one and/or restore/realign the stream channel at Rte. 633, Tributary to Quantico Creek (Dewey's Creek), Prince William County, Virginia. The undersized culvert's function was compromised during Sandy by not passing the sediment load, causing the structure to become 75%+/- (visual observation) clogged with sediment. Previous structures at the site have had a history of overtopping during high flow events. Without remediation, structural integrity will be further compromised during future high flow events to include potential road failure due to overtopping, and by damage to an existing public water main upstream and adjacent to the culvert. The site currently serves as a partial blockage to fish passage for American eel and possibly river herring. The culvert will be replaced with one sized adequately to handle high flow events, including possible stream realignment relative to the creek's course into the culvert. The socioeconomic benefit of this project is estimated at \$3.1M.

DOI # 50

Project Title and Amount:

Increasing Water Management Capability at Great Dismal Swamp National Wildlife Refuge to Enhance its Resilience for Wildlife and People – \$3,130,000

Conservation/Resilience Goals: The goal of the project is to improve the ability of the refuge to manage water levels for flood control, fire suppression and habitat management. At the end of this project, the refuge will have installed or replaced 15 water control structures to increase water management capability. Increased groundwater storage will:

- Reduce flooding impacts to nearby communities
- Increase water storage available for the inter-coastal waterway (Dismal Swamp Canal)
- Reduce fire vulnerability of carbon-rich peat soils to drought events
- Reduce wildfire smoke impacts on public health and the tourism in surrounding urban areas
- Increase hydrologic conditions favorable for peat accumulation and carbon sequestration
- Improve wildlife habitat diversity and resilience
- Improve and protect water quality

Brief Project Summary: The project will implement large-scale hydrologic restoration and management to increase water storage of drained forested peatlands, making them more resilient to the effects of climate change (storms, wildfires, and drought). The project includes planning, implementation, and monitoring.

DOI # 76**Project Title and Amount:**

Living Shoreline-Oyster Reef Restoration and Construction at Chincoteague National Wildlife Refuge, VA – \$553,425

Conservation/Resilience Goals:

- Construct 1,000 linear feet of living shoreline along the Tom's Cove section of the beach access road at Chincoteague NWR (composed of oyster castles, an alternative substrate utilized in oyster restoration)
- Construct two acres of oyster reef composed of dredged fossil oyster shell in Tom's Cove offshore of the beach access road
- Construct 2,650 linear feet of living shoreline along the low water mark across the cove along the service road at the North Wash Flats on Chincoteague NWR

Brief Project Summary: The US Fish and Wildlife Service, in partnership with the National park Service, The Nature Conservancy, Virginia Department of Game and Inland Fisheries and the Virginia Marine Resources Commission, proposes to construct two living shoreline projects and two acres of oyster reefs on the Chincoteague National Wildlife Refuge that will help restore and rebuild the refuge after impacts associated with Hurricane Sandy.

Science

DOI # 17

Project Title and Amount:

Building a predictive model for submerged aquatic vegetation prevalence and salt marsh resilience in the face of Hurricane Sandy and sea level rise (\$217,000).

Conservation/Resilience Goal: To fully understand how climate change and severe storms affect saltmarsh ecosystems, the unique submerged aquatic vegetation (SAV) complex, and the species that exclusively use them (e.g. Atlantic brant), it is important to build predictive models for SAV prevalence pre and post-Sandy as well as in future sea-level rise scenarios for improved management of saltmarsh management and resilience. To accomplish this broad goal, this research proposes to develop 5 products including: (1) Estimate available submerged aquatic vegetation (SAV) in the Mid-Atlantic using Thematic Mapping and build a predictive model for identifying future prevalence; (2) Apply energy density values to SAV availability estimates (from #1) to estimate landscape level energy available to the specialist SAV consumer, the Atlantic brant; (3) Relate current brant population size and energetic requirements to determine if positive or negative imbalances exist; (4) Forecast future brant carrying capacities by potential changes in the abundance and distribution of SAV that result from SLR as well from satellite imagery pre and post Hurricane Sandy; and (5) Provide Federal lands with information on what salt marsh and SAV beds were most negatively impacted to improved future management plans for increasing the resilience of coastal habitats.

Brief Project Summary: This research will provide a quantitative assessment of Hurricane Sandy's impact on submerged aquatic vegetation within the green infrastructure of saltmarsh ecosystems; and as a result, Atlantic brant populations. Specifically, by evaluating the effect of: 1) Hurricane Sandy on SAV and brant food supplies, and 2) future impacts of sea-level rise on SAV resources, we will be able to provide written recommendations to regional DOI agencies for the most effective management actions to maintain, restore, and enhance the resilience of tidal marsh habitats and the ecosystem services they provide. We foresee this information being critical for directing short-term restoration efforts along with long-term planning.

DOI # 24

Project Title and Amount:

Decision Support for Hurricane Sandy Restoration and Future Conservation to Increase Resilience of Tidal Wetland Habitats and Species in the Face of Storms and Sea Level Rise – \$2,200,000

Conservation/Resilience Goals:

- Completion of decision support models for tidal wetlands and tidal wetland species that is used by DOI and other partners for decisions on future wetland management, restoration and protection
- A coordinated monitoring program that evaluates and determines the effectiveness of marsh restoration in increasing persistence and resilience of tidal marsh habitats and species
- Availability and use of these results and tools by partners at regional, state and local scales

Brief Project Summary:

Decisions on allocation of resources for tidal wetland restoration efforts in response to Hurricane Sandy impacts and future allocation of resources for wetland conservation efforts need to be guided by an understanding of which actions at which sites in the North Atlantic will be the most likely to increase the persistence of these marsh systems and the services they provide such as flood abatement, wildlife and fisheries habitat and recreation. This project would implement a coordinated effort to increase persistence of tidal marshes among many partners: Atlantic Coast LCCs, FWS, USGS, NPS, Climate Science Centers, NOAA,

regional ocean partnerships, states, universities, and NGOs. The work would integrate existing monitoring results, models and tools with foundational data and impact assessments and deliver that information to guide decisions about where to conduct tidal marsh restoration, conservation and management to sustain ecological values (habitat suitability, connectivity and resilience) and ecosystem services. Initial focus will be on tidal wetlands in New York and New Jersey including National Wildlife Refuges and National Parks most impacted by Hurricane Sandy but will be applied to other coastal states most impacted. This project would integrate and deliver results from existing DOI and NOAA sea level rise and wetland response models, wildlife habitat suitability projects, LCC decision support projects; resilience approaches by The Nature Conservancy and ongoing efforts to deliver information to states and communities through LCC, NOAA and the regional ocean partnerships. This project also depends upon, complements, utilizes and integrates foundational data, impact assessments and modeling by USGS.

DOI # 30

Project Title and Amount:

A Stronger Coast: Three USFWS Region 5 Multi-National Wildlife Refuge Projects to Increase Coastal Resilience and Preparedness – \$2,060,000

Conservation/Resilience Goals:

- Enable our sandy shores, expansive marshes and maritime margins to bear future storms with greater resilience
- Preserve the species they support and buffer human coastal communities from harm
- Shoreline survey and Analysis: Complete the first 5-year interval for R5 NWR sandy shorelines and conduct a risk analysis
- Salt Marsh Integrity Assessment: Complete assessments on all R5 salt marsh refuges and identify priority parcels for resilience restoration
- Integrated Waterbird Management Monitoring: Expand project to additional refuges in Region 5 and provide supplemental funding to currently participating refuges to obtain more comprehensive coverage along the Northeastern coast

Brief Project Summary:

Shoreline Survey: 12 National Wildlife Refuges/Complexes; over 70 miles of shoreline The magnitude and rate of shoreline change affects the quality of natural and cultural resources as well as infrastructure present within and along our coastal refuges. We will identify the seasonal, annual and long-term trends and vulnerability of shorelines and beach-dune topography on our coastal refuges as a part of the basis for understanding the coastal geomorphological system.

Salt Marsh Integrity Assessment: Our on-going SMI assessments will provide each refuge and the regional office an objective basis for determining the relative “health” (including resilience) of each salt marsh unit and restoration needs. When SMI assessments are completed for the entire northeast region, we can then manage resilience and restoration efforts at both local and regional scales, identifying the most valuable and vulnerable parcels.

IWMM: Combined with the other two projects listed here and the SHARPs project submitted separately, we will be able to identify waterbird population trends on a landscape scale and identify crucial locations to provide increased resilience in the face of future storms.

DOI # 32

Project Title and Amount:

Resilience of the Tidal Marsh Bird Community to Hurricane Sandy and Assessment of Restoration Efforts - \$1,573,950

Conservation/Resilience Goal: This project will provide the evaluation and assessment metrics and tools to:

- Assess the damage caused to tidal marshes across the full gradient of Hurricane Sandy impacts
- Prioritize tidal marsh sites across the region in most need of long-term restoration
- Quantify the effectiveness of tidal marsh restoration projects using standardized protocols
- Use pre- and post- Hurricane Sandy data to develop a standardized multi-metric tool to quantify the conservation value of tidal marshes based on their natural resilience to disturbance, and their ability to provide ecosystem services and support wildlife. This tool will be used to score all DOI and non-DOI tidal marshes from Virginia to Maine and provide a framework for quantifying the natural resilience capacity of these systems and their ecological value to Species of Greatest Conservation Need.

Brief Project Summary: A thorough understanding of the effects of Hurricane Sandy on tidal marshes and the wildlife they support is needed to direct remediation funds where they will have the greatest efficacy. Local and severe alteration of individual marshes is apparent, but the extent of the damage across thousands of hectares of marsh habitat within the storm's path and the impacts on wildlife remain unknown. Many bird species of conservation concern breed in tidal marshes (American black duck, clapper, king and black rails, willet, seaside, Nelson's and saltmarsh sparrows), and as such already face increased threats from sea level rise. Understanding plant community and bird responses to this extreme storm will ensure that immediate action can be directed to areas that will benefit most, planned restoration can adopt an adaptive management approach that is data-driven and scientifically rigorous, and conservation priorities for increasing resource resilience for an increasingly stormy future can be developed.

DOI #63

Project Title and Amount: *Collaboratively Increasing Resilience and Improving Standards for Culverts and Road Stream Crossings to Prevent Future Floods While Restoring Aquatic Connectivity* - \$1,270,000

Conservation/Resilience Goals:

- Identify, survey, map and prioritize road crossing/culvert repair and replacement projects to maximize stream connectivity and post-flood resilience in states impacted by Hurricane Sandy.
- Improve road crossing/culvert replacement standards to withstand future flood events, including predicted future storm discharges due to climate change.
- Improve fish passage in streams in the Hurricane Sandy affected area.
- Improve understanding, knowledge, and support for culvert/road crossing replacement implementation that is designed to withstand floods and improve fish passage.

Brief Project Summary:

Hurricane Sandy, along with other recent storms including Tropical Storm Irene, had major impacts on poorly-designed or undersized road stream crossings. Aquatic systems in the northeast are extremely fragmented as many of these crossings provide little or passage for fish and other aquatic organisms. This project will develop a science- and partner-driven approach to identifying and prioritizing culvert and road

stream crossing repair and replacements in the Hurricane Sandy area to increase resilience to future floods and improve fish passage.

Building on previous efforts, this project will develop a database and maps of road stream crossings based on existing data and models, support additional surveys of road stream crossings, predict future storm discharge levels, and develop models to prioritize crossing improvements and assess risk based on multiple ecological factors. The project will also include support for training and capacity to work with local and state users, be guided and supported by partners and users from the conservation, transportation, and state and municipal planning sectors, and be facilitated by the North Atlantic Landscape Conservation Cooperative and the Fisheries Program of the U.S. Fish and Wildlife Service with broad partner involvement and support.

Youth and veterans will be engaged to help collect required field data using existing protocols. Local communities will receive a socio-economic return estimated at \$500,000 per mile of stream access restored.

DOI # 64

Project Title and Amount:

Coastal Barrier Resources System Comprehensive Map Modernization: Supporting Coastal Resilience and Sustainability following Hurricane Sandy - \$5,000,000.

Conservation/Resilience Goal: This project will increase the resilience and capacity of coastal habitat and infrastructure to withstand storms and reduce the amount of damage caused by such storms by adding new qualifying lands to the Coastal Barrier Resources System (CBRS). Addition will remove taxpayer subsidies for flood insurance, coastal infrastructure, and disaster assistance within the designated areas. Expansion of the CBRS will enhance the capacity of coastal barriers and wetlands to protect mainland communities from coastal storms, conserve important habitat for many fish and wildlife species, and increase public safety by reducing the intensity of development within these areas.

Brief Project Summary: This project is for the comprehensive modernization of the official maps of the John H. Chafee Coastal Barrier Resources System along the North Atlantic coast. Modernized CBRS maps can serve as mitigation tools that help communities plan for long-term resilience by steering development away from vulnerable coastal natural resources that are susceptible to the effects of climate change such as sea-level rise and more frequent and intense coastal storms.

DOI # 67

Project Title and Amount:

Decision Support for Hurricane Sandy Restoration and Future Conservation to Increase Resilience of Beach Habitats and Beach-Dependent Species in the Face of Storms and Sea Level Rise – \$1,750,000

Conservation/Resilience Goals:

- Completion of decision support models for coastal beaches that are used for decisions by DOI, other federal agencies, states and communities on future beach management and restoration
- Coordination of a monitoring program to evaluate the effectiveness of beach restoration and management in increasing persistence and resilience of beach habitats and species
- Availability and use of these results and tools by partners at regional, state and local scales

Brief Project Summary:

Coordinated effort through the LCCs working with DOI Bureaus, Climate Science Centers (CSCs), coastal states, tribes, NGOs and university partners to integrate existing monitoring results, models and tools with foundational data and impact assessments to guide decisions about where to conduct beach restoration, conservation and management to sustain ecological values, ecosystem services and habitat suitability of beaches in the face of storm impacts and sea level rise in the Hurricane Sandy region. This includes integration and expansion of results from an ongoing sea level rise modeling project to couple predictive models of sea level rise, beach geomorphology, and habitat for piping plovers. These decision support models will be expanded from Maryland and Virginia to include New Jersey, New York and other states impacted by the Hurricane. Data from past and ongoing studies of beach stabilization projects will be incorporated to inform near-term resilience projects as well as longer-term planning for conservation of sensitive habitats in the face of sea level rise and storms. The project focuses on sustaining integrity of coastal beaches, ecosystem services provided by these beaches including flood abatement and persistence of sensitive beach species. The threatened piping plover will serve as a surrogate species for habitat modeling, but implications for oystercatchers, least terns, black skimmers, sea beach amaranth (federally-threatened plant), northeastern beach tiger beetle (federally threatened insect), red knot (candidate for ESA listing), and other migrating shorebirds will be addressed in depth.